

SIRTF* and WIRE**

presented at

**NGST Science Conference
Goddard Space Flight Center
April 7, 1997**

*Michael Werner
SIRTF Project Scientist/WIRE co-Investigator
Jet Propulsion Laboratory*

*SIRTF = Space Infrared Telescope Facility
<http://sirtf.jpl.nasa.gov/sirtf/home.html>

**WIRE = Wide Field Infrared Explorer
<http://www.ipac.caltech.edu/wire/>

SIRTF Status

SIRTF team completed, July 1996. Team members are:

JPL for Project Management and system/mission engineering

Lockheed Martin for spacecraft and for system integration and test

Ball Aerospace for cryogenic telescope assembly and for MIPS

(Arizona) and IRS(Cornell) instruments

Goddard Space Flight Center for IRAC(SAO) instrument

IPAC for science operations

SIRTF entered Phase B: October 1, 1996

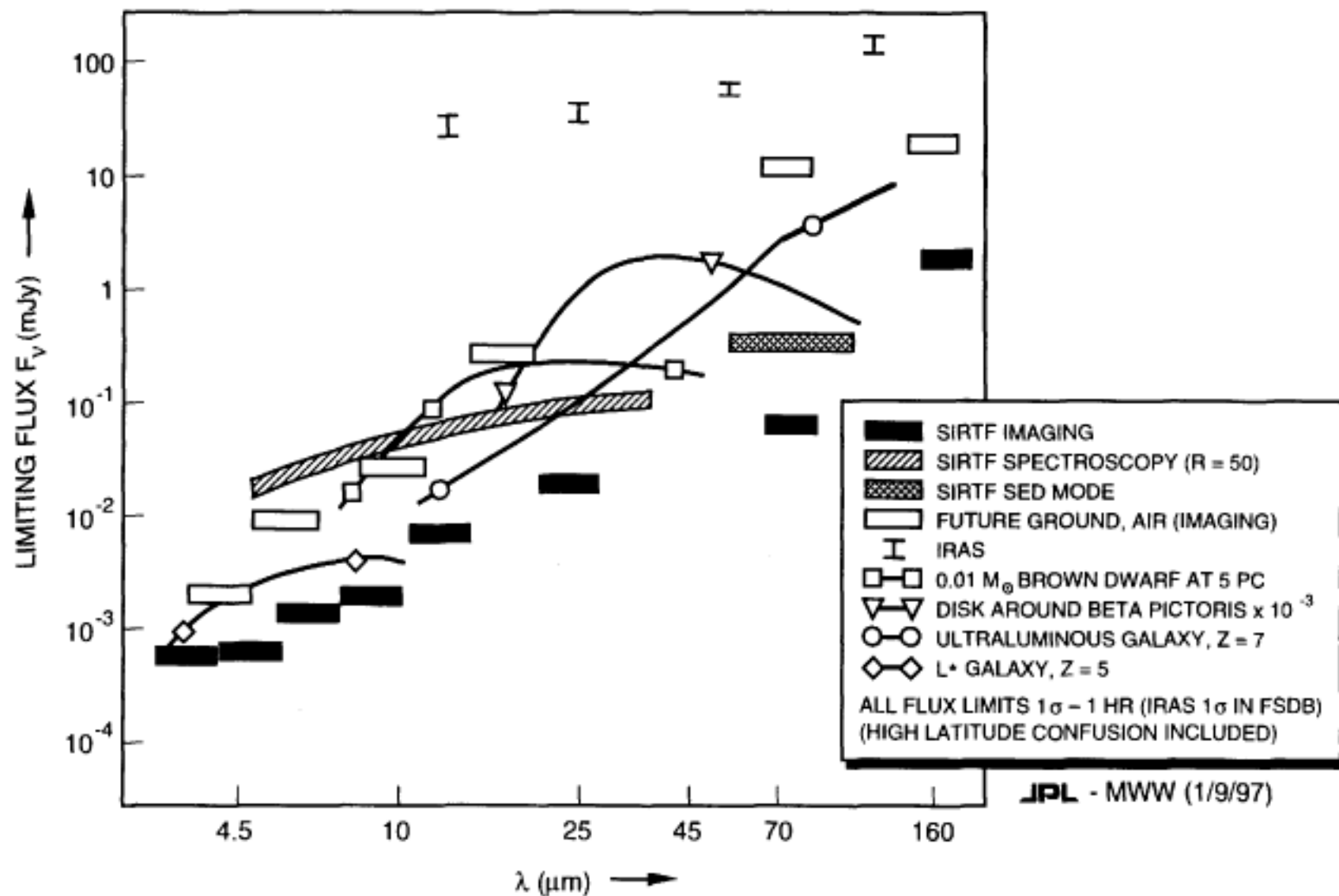
Prospects encouraging for SIRTF new start in Spring, 1998

Launch scheduled as early as December 1, 2001



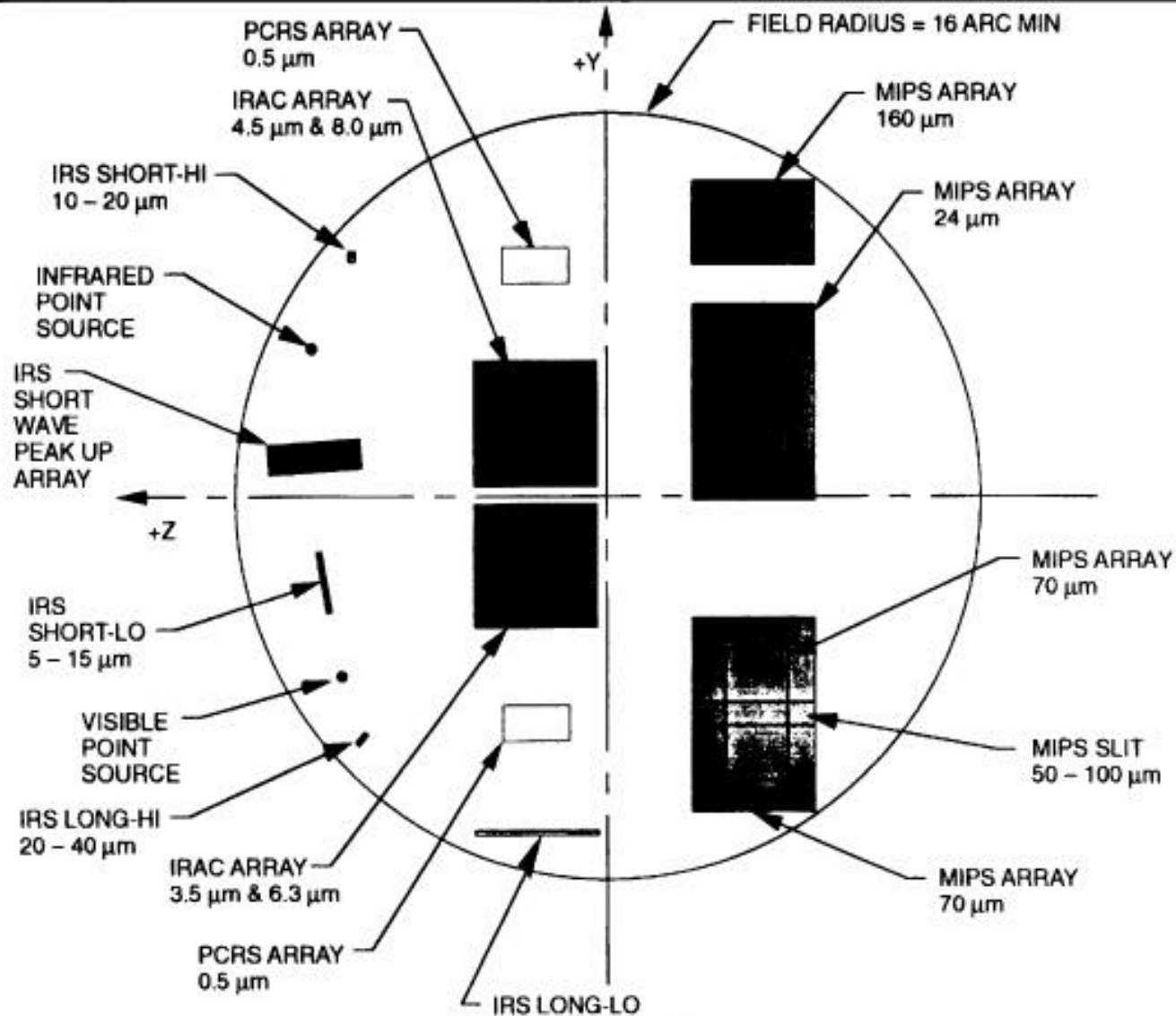
SIRTF SUMMARY

APERTURE	85 cm
LIFETIME	2.5 yr
DIFF. LIMIT	6.5 μm
IMAGE SIZE	~1.5"
POINTING STAB.	0.3" rms
ORBIT	SOLAR
WAVELENGTH RANGE	
IMAGING	3.5–160 μm
SPECTRA	5–40 μm
S.E.D. Mode	50–100 μm
FIELD OF VIEW	~5'x5' each band
PLANETARY TRACKING	~0.1 arcsec/sec
LAUNCH DATE	2001





Cold Assemblies Field of View Allocations



SIRTF - Short Wavelength Detector Status

Material	InSb	Si:As (IBC)
Format	256x256	256x256
Operability	99.7%	>99.9%
Pixel Size	30 μ m	30 μ m
Operating Temperature	15K	6K
Power Dissipation	0.3mW	<1 mW
DQE	87%	40%
Read Noise	10 electrons*	12 electrons**
Dark Current	<0.2 electrons/s	1 electrons/s

- - *200 second integration time/64 nondestructive sample pairs
- - ** 1 second integration time/64 nondestructive sample pairs

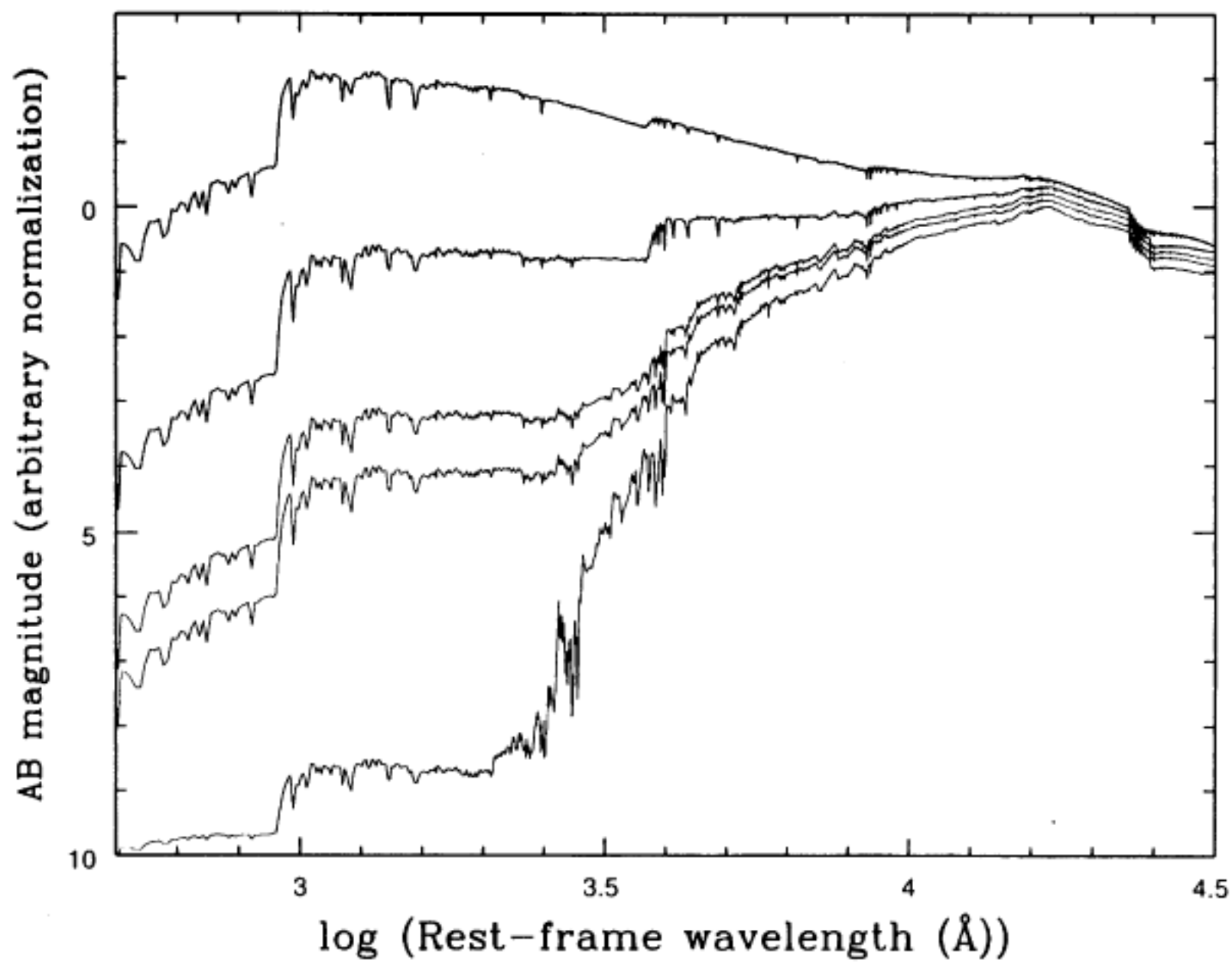
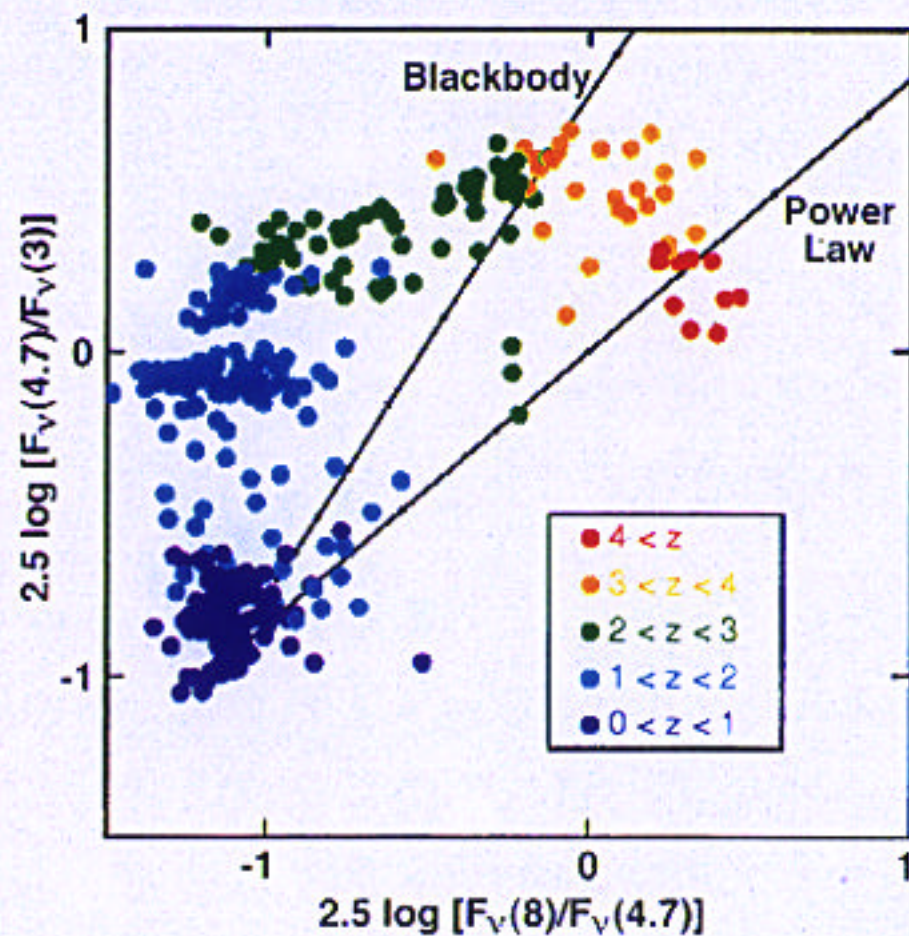
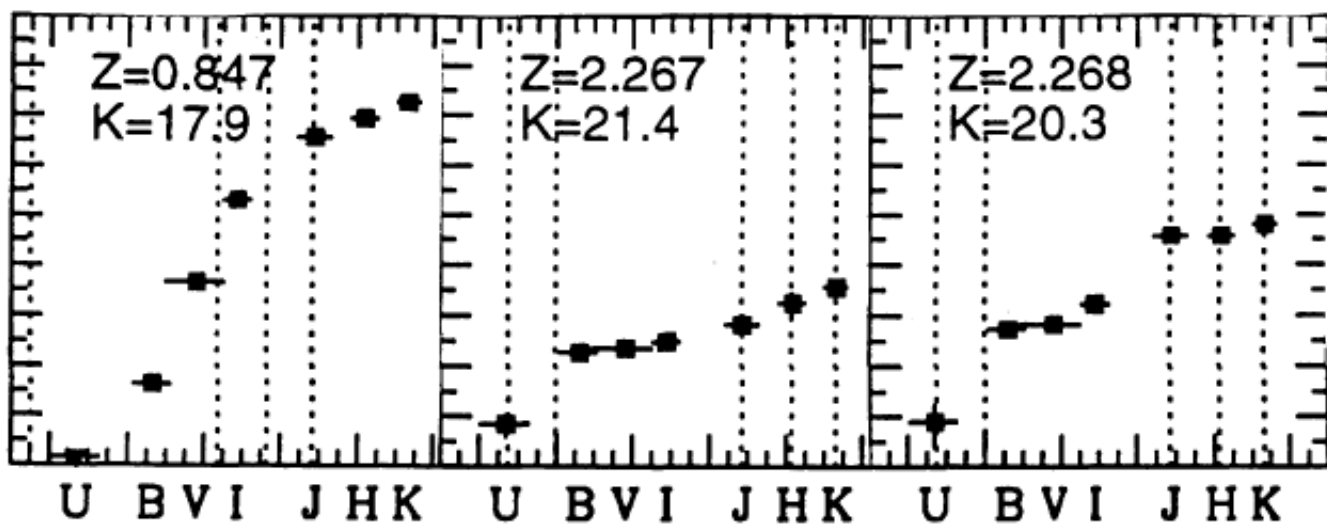


Figure 7. Spectra for Bruzual & Charlot (1996) galaxy models shown in figure 3.

Galaxies in the Early Universe



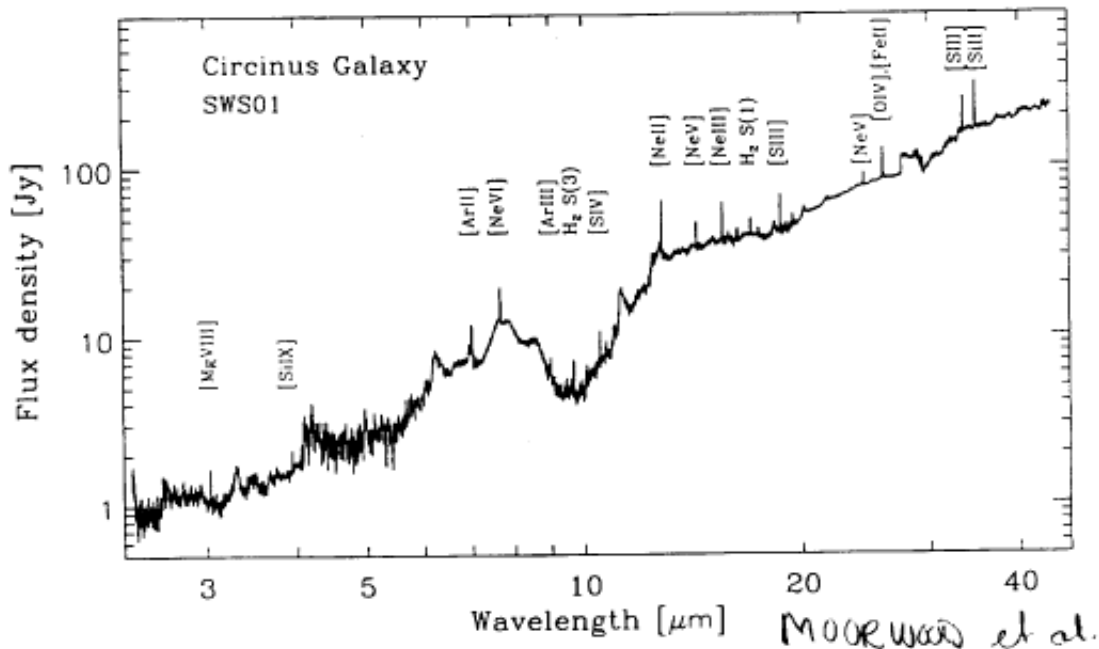
Starlight from Distant Galaxies



Observed spectral energy distributions of HDF galaxies. IR data from Dickinson, Eisenhardt, et al. The vertical red line denotes rest frame $H\alpha$, the blue arrow is the SIRTTF limit $\{\sim 2.5 \mu\text{Jy } 4-\sigma\}$ from 3-8 μm .

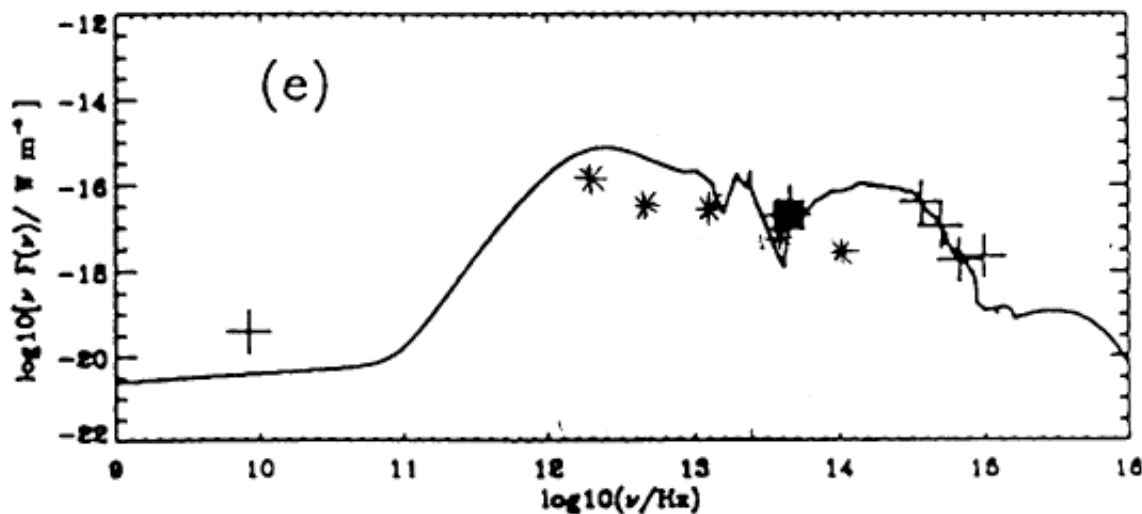
SIRTTF can extend the spectral energy distributions for distant galaxies - such as those with $z \sim 3$ found in the HDF - to cover the rest frame J, H, and K bands, providing a reddening-insensitive determination of galaxy mass and age, and noting deviations from our current predictions

Active Galactic Nuclei



The nearby Circinus Galaxy - the nearest AGN - has $L \sim 10^{10} L(\text{sun})$ and IR fine structure line fluxes $\sim 40\text{-}100 \times 10^{-16} \text{ W/m}^2$. Scaling from Circinus, SIRTIF, with a line sensitivity $\sim 3 \times 10^{-18} \text{ W/m}^2$, could study the excitation of $10^{12} L(\text{sun})$ AGN to $z > 0.5$, and their continua to $z > 2$.

Very Distant IR-Luminous Galaxies



*Observed spectral energy distribution of ISO HDF 123643.9 (Rowan-Robinson et al) fit to redshifted starburst model from Rowan-Robinson and Efstathiou. SIRTf detection limits, 5σ in 500 sec, are shown as *.*

SIRTf can measure continuum emission and total luminosities of starbursts similar to those inferred to be occurring in the HDF to well beyond $z \sim 3$, providing a means of determining the star formation history of the Universe. SIRTf can also measure ULG's like FSC15307 to $z > 5$, searching for the epoch of dust and heavy element formation.

Community Utilization of SIRTf

More than 75% of the observing time on SIRTf will be available to the community through a peer-reviewed selection process. A community-based SIRTf Community Task force has been formed to help the science community plan and prepare for its use of SIRTf. Its activities include:

SIRTf User Community Workshops - annual at Jan AAS meeting

SIRTf Time Estimator - now available on SIRTf Web site

SIRTf Science Activity Time Line

- main prelaunch milestones are:

Now through 1999 December - Science Conferences and Workshops

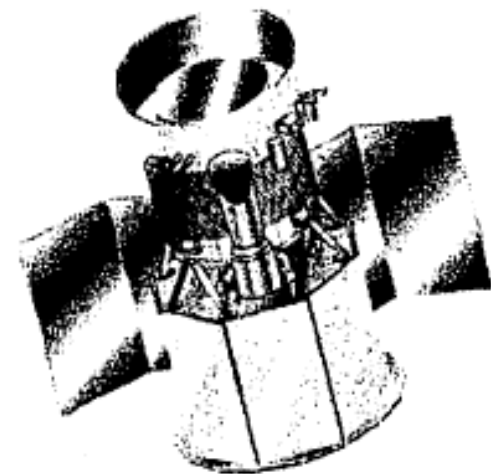
1999 December - NRA for Legacy Science Proposals

2001 January - NRA for General Observers and Archival Researchers

WHAT IS WIRE?

WIRE XXXXXXXXXX Wide-Field Infrared Explorer

- Cryogenically-cooled, 30cm, IR telescope designed to determine the evolutionary history of starburst galaxies and to search for protogalaxies at 12 and 25 μ m.
- Selected in 1994 as NASA's fifth Small Explorer (SMEX) mission (2nd astrophysics SMEX mission).
- Hardware is under development.
- To be launched in 1998.



INSTRUMENT OVERVIEW

WIRE

Wide-Field Infrared Explorer

Telescope	30cm Ritchey-Chretien
Detectors	128x128 Si:As BIB arrays
Passbands	21-27 μ m, and 9-15 μ m
Field of View	33 x 33 arcminutes
Pixel size	75 μ m, or 15.5 arcsec
Spatial resolution	24 arcsec @ 25 μ m, 20 arcsec @ 12 μ m
Cryostat	Dual-stage, solid hydrogen
Operating temps.	< 7 K (arrays), 12 K (optics)
Cryogen lifetime	> 4 months
Pointing jitter	< 6 arcsec radial RMS
Orbit	450 km, 97 deg. inclination, Sun-synchronous orbit
Launch vehicle	Air-launched Pegasus XL
Launch date	September 1998

WIRE SCIENCE OBJECTIVES

WIRE

Wide-Field Infrared Explorer

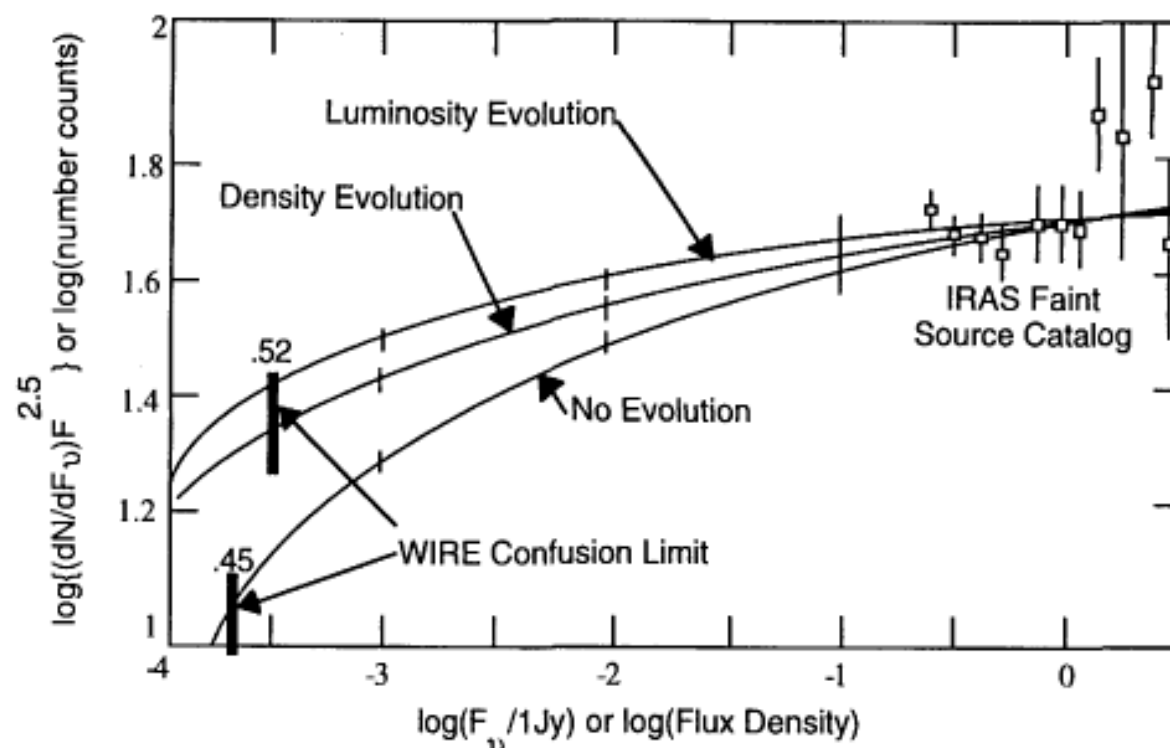
To answer 3 questions:

1. What fraction of the luminosity of the Universe at a redshift of 0.5 and beyond is due to starburst galaxies?
2. How fast and in what ways are starburst galaxies evolving?
3. Are luminous protogalaxies common at redshifts less than 3?

25 μm NUMBER COUNTS

WIRE

Wide-Field Infrared Explorer



- The WIRE survey will be able to estimate the rate of starburst galaxy evolution

**WIRE Survey Description
Modest Evolution Assumption**

Survey	Sky Coverage	25 μ m Flux-limit ($5\sigma^*$)	# of sources
Moderate depth	830 deg ²	1.5 mJy	>70,000
Deep	42 deg ²	0.56 mJy	14,000
Confusion-distribution measurement	1 deg ²	0.34 mJy	700

No Evolution Assumption

Survey	Sky Coverage	25 μ m Flux-limit ($5\sigma^*$)	# of sources
Moderate depth	170 deg ²	0.69 mJy	>30,000
Deep	8.3 deg ²	0.25 mJy	5,000
Confusion-distribution measurement	0.5 deg ²	0.17 mJy	500

* 12 μ m sensitivity is expected to be ~ 3-times fainter


SCIENCE TEAM

WIRE

Wide-Field Infrared Explorer

Perry Hacking	• Vanguard Research/JPL
Nick Gautier	• Jet Propulsion Laboratory
Terry Herter	• Cornell University
Carol Lonsdale	• IPAC/Caltech
David Shupe	• IPAC/Caltech
Gordon Stacey	• Cornell University
Tom Soifer	• Caltech
Mike Werner	• Jet Propulsion Laboratory
Harvey Moseley	• Goddard Space Flight Center
Paul Graf	• Ball Technologies
Jim Houck	• Cornell University
Helene Schember	• Instr Proj Mgr • Jet Propulsion Laboratory

WIRE Associated Investigator Program

WIRE  Wide-Field Infrared Explorer

We are looking for a few good collaborators!

- ~1500 orbit segments (~10% of mission) available along Galactic and ecliptic planes
- A single segment image is 100X more sensitive than IRAS FSC with 10X better areal resolution, over 0.5x0.5 deg field
- 12 μ m band covers solid-state aromatic features (PAHs), 25 μ m band is "PAH"-free
- Observations and resulting data are only **18 months** away.

AI PROGRAM, cont'd

WIRE

Wide-Field Infrared Explorer

- See most recent NASA ADP Announcement of Opportunity
- Peer review this Spring, funding in Summer.
- ~Three groups envisioned.
- Initial funding level ~\$60K/team. More later.
- WIRE science team members will collaborate
- WIRE science team decides on appropriate time allocation for groups.

SIRTF and WIRE - Summary

- **The road from HST to NGST leads through SIRTF**

First observations of hi-z galaxies at 3-to-8 um

Major advances in most other NGST science areas

Demonstration of key technologies:

Radiative cooling & High efficiency cryogenic systems

Lightweight cryogenic optics

Ultrasensitive infrared arrays

- **WIRE will provide valuable complementary data**

Survey of star formation in the local Universe

First use in space of large format IBC arrays

- **Near term opportunities exist for participation in both SIRTF and WIRE**